

I claim:

1. A separator for a mist collection system comprising:
 - a) a cylindrical tube provided with inlet and exit openings to allow air to be
5 drawn therethrough,
 - b) a set of stationary vanes connected in the upstream portion of the tube and
sized and positioned to direct the air flowing therethrough in a cyclonic path
through the tube such that mist in the air therein migrates outwardly to and in the
downstream direction along the inside wall of the tube,
 - 10 c) an annular collection chamber defined in the downstream end of the tube
and having an annular upstream opening coincident with the inside wall of the
tube such that liquid flowing along the inside of the tube toward the downstream
end thereof flows directly into the collection chamber,
 - d) an annular flow restrictor positioned at the upstream opening of the
15 collection chamber and sized for free flow of liquid along the inside wall of the
tube into the chamber and for blocking back-flow out of the chamber,
 - e) a drain hole positioned near the downstream end of the collection
chamber, and
 - f) a flow interrupter projecting into the collection chamber to direct the
20 liquid therein into the drain.

2. The separator of claim 1 in which the flow restrictor is sized to provide radial clearance with the inside cylindrical wall of the tube of between approximately one-fourth (1/4) to one-half (1/2) inch.
- 5 3. The separator of claim 1 in which the flow restrictor diverges conically in the downstream direction to define a converging entrance to the chamber.
4. The separator of claim 1 in which the flow interrupter includes a first portion that projects generally radially from and extends longitudinally along the inside wall of the
10 tube.
5. The separator of claim 4 in which the flow interrupter further includes a second portion that extends substantially circumferentially from the first portion.
- 15 6. The separator of claim 1 in which the flow interrupter is connected to project from downstream of the drain with respect to the swirling flow of liquid in the collection chamber to a position generally radially inwardly of the drain.

7. The separator of claim 1 in which the vanes (i) are provided with leading edges set at an angle of approximately 25 degrees with respect to the inlet opening, and (ii) extend substantially longitudinally therefrom at an angle of approximately 35 degrees with respect to a longitudinal axis therethrough and for longitudinal distance of approximately
- 5 four and one-half (4-½) inches.

8. A separator for a mist collection system comprising:
- a) inlet and exit couplings provided with inlet and exit openings, respectively, to allow air to be drawn therethrough,
 - b) upstream and downstream annular walls extending outwardly from the inlet and exit couplings proximate the inlet and exit openings, respectively,
 - c) an outer cylindrical tube connected between the upstream and downstream annular walls coaxial with and located radially outwardly of the inlet and exit openings to define (i) an upstream expansion chamber into which the air flow enters upon flowing through the inlet opening and (ii) a centrally located, open separation chamber downstream of the expansion chamber,
 - d) a set of stationary vanes fixed in the expansion chamber and sized and positioned to direct the air flowing therethrough in a cyclonic path into the separation chamber such that mist in the air therein migrates radially outwardly to and in the downstream direction along the inside wall of the outer tube,
 - e) an inner cylindrical tube extending forwardly from the downstream annular wall radially inwardly of the outer tube portion, the inner tube cooperating with the outer tube and the downstream wall to define an annular dead-ended collection chamber bounded therebetween and having an upstream annular opening coincident with the inside wall of the outer tube into the separation chamber such that liquid flowing toward the downstream end along the inside wall of the outer tube flows directly into the collection chamber,

- f) an annular flow restrictor extending outwardly from the upstream end portion of the inside tube to define a converging flow path entrance into the collection chamber, the flow restrictor being sized to provide radial clearance with the inside wall of the outer tube of between approximately one-fourth (1/4) to one-half (1/2) inch, and
- g) a drain hole positioned near the downstream end of the collection chamber for discharging the liquid collected in the chamber.
9. The separator of claim 8 in which the flow restrictor diverges conically outwardly in the downstream direction.
10. The separator of claim 8 in which the vanes (i) are provided with leading edges set at an angle of approximately 25 degrees with respect to the inlet opening, and (ii) extend substantially longitudinally therefrom at an angle of approximately 35 degrees with respect to a longitudinal axis therethrough and for longitudinal distance of approximately four and one-half (4-½) inches.
11. The separator of claim 8 further comprising a flow interrupter positioned in the collection chamber to direct liquid therein into the drain.
12. The separator of claim 12 in which the flow interrupter extends longitudinally along the downstream end portion of the collection chamber.

13. The separator of claim 12 in which the flow interrupter is connected to extend from downstream of the drain with respect to the swirling flow of liquid in the collection chamber to a position generally radially inwardly of the drain hole.

14. A mist collection system for machine-tool liquids comprising:

- a) an inlet,
- b) an outlet,
- c) a fan to draw mist-contaminated air through the inlet and to discharge the
5 air through the outlet,
- d) a cyclonic mist separator connected between the inlet and the outlet such
that mist-contaminated air is drawn therethrough by the fan, the separator having
 - i) an inside cylindrical wall through which the air flows,
 - ii) a set of stationary vanes positioned in the upstream portion of the
10 cylindrical wall, the vanes being sized and positioned to direct the air
flowing therethrough in a cyclonic path such that mist therein migrates
outwardly to and flows downstream along the cylindrical wall,
 - iii) a collection chamber extending coaxial from the cylindrical wall
such that liquid flowing toward the downstream end of the cylindrical wall
15 flows into the collection chamber,
 - iv) a drain hole positioned near the downstream end of the collection
chamber for discharging the liquid therefrom, and
 - v) a flow interrupter configured to interrupt the flow of liquid in the
collection chamber and to direct the liquid therein into the drain hole such
20 that the separator pre-cleans mist from the air, and
- e) a final mist-cleaning station downstream of the cyclonic mist separator
through which the pre-cleaned air flows for final cleaning.

15. The separator of claim 14 further comprising a flow restrictor positioned at the inlet of the collection chamber; the flow restrictor being sized for free flow of liquid along the inside cylindrical wall into the collection chamber and for blocking back-flow out of the collection chamber.

16. The mist collection system of claim 15 in which the flow restrictor is sized to provide radial clearance with the cylindrical wall of between approximately one-fourth (1/4) to one-half (1/2) inch.

17. The separator of claim 16 in which the flow restrictor diverges conically in the downstream direction.

18. The separator of claim 15 in which the flow interrupter is connected to project from downstream of the drain with respect to the swirling flow of liquid in the collection chamber to a position generally inwardly of the drain.

19. The separator of claim 15 in which the vanes (i) are provided with leading edges set at an angle of approximately 25 degrees with respect to the inlet opening, and (ii) extend substantially longitudinally therefrom at an angle of approximately 35 degrees with respect to a longitudinal axis therethrough and for longitudinal distance of approximately four and one-half (4-1/2) inches.

20. The separator as defined in claim 15 in which the flow interrupter includes (a) a reservoir located radially outwardly of the collection chamber and in fluid communication with the drain, and (b) a transition opening establishing fluid communication between the
5 collection chamber and the reservoir, the transition opening being defined in part with an inlet-side transition edge extending longitudinally in the tube upstream of the drain with respect to the swirling liquid in the collection chamber.

21. A separator for a mist collection system comprising:
- a) inlet and exit couplings provided with inlet and exit openings, respectively, to allow air to be drawn therethrough,
 - b) upstream and downstream annular walls extending outwardly from the inlet and exit couplings proximate the inlet and exit openings, respectively,
 - c) an outer cylindrical tube connected between the upstream and downstream annular walls coaxial with and located radially outwardly of the inlet and exit openings to define (i) an upstream expansion chamber into which the air flow enters upon flowing through the inlet opening and (ii) a centrally located, open separation chamber downstream of the expansion chamber,
 - d) a set of stationary vanes fixed in the expansion chamber and sized and positioned to direct the air flowing therethrough in a cyclonic path into the separation chamber such that mist in the air therein migrates radially outwardly to and in the downstream direction along the inside wall of the outer tube, the vanes (i) being provided with leading edges set at an angle of approximately 25 degrees with respect to the inlet opening, and (ii) extending substantially longitudinally therefrom at an angle of approximately 35 degrees with respect to a longitudinal axis therethrough,

e) an inner cylindrical tube extending forwardly from the downstream annular wall radially inwardly of the outer tube portion, the inner tube cooperating with the outer tube and the downstream wall to define an annular dead-ended collection chamber bounded therebetween and having an upstream annular opening coincident with the inside wall of the outer tube into the separation chamber such that liquid flowing toward the downstream end along the inside wall of the outer tube flows directly into the collection chamber,

f) an annular flow restrictor extending outwardly from the upstream end portion of the inside tube to define a converging flow path entrance into the collection chamber, and

g) a drain hole positioned near the downstream end of the collection chamber for discharging the liquid collected in the chamber.

22. The separator of claim 21 in which the flow restrictor diverges conically outwardly in the downstream direction.

23. The separator of claim 21 in which the vanes extend for longitudinal distance of approximately four and one-half (4-½) inches.

24. The separator of claim 21 further comprising a flow interrupter positioned in the collection chamber to direct liquid therein into the drain.

25. The separator of claim 24 in which the flow interrupter extends longitudinally along the downstream end portion of the collection chamber.
26. The separator of claim 24 in which the flow interrupter is connected to extend
5 from downstream of the drain with respect to the swirling flow of liquid in the collection chamber to a position generally radially inwardly of the drain hole.
27. A separator for a mist collection system comprising:
- a) a cylindrical tube provided with inlet and exit openings to allow air to be
10 drawn therethrough,
- b) a set of stationary vanes connected in the upstream portion of the tube and sized and positioned to direct the air flowing therethrough in a cyclonic path through the tube such that mist in the air therein migrates outwardly to and in the downstream direction along the inside wall of the tube, the vanes (i) being
15 provided with leading edges set at an angle of approximately 25 degrees with respect to the inlet opening, and (ii) extending substantially longitudinally therefrom at an angle of approximately 35 degrees with respect to a longitudinal axis therethrough,
- c) an annular collection chamber defined in the downstream end of the tube
20 and having an annular upstream opening coincident with the inside wall of the tube such that liquid flowing along the inside of the tube toward the downstream end thereof flows directly into the collection chamber,

- d) a drain positioned near the downstream end of the collection chamber, and
- e) a flow interrupter configured to interrupt the flow of liquid in the collection chamber and to direct the liquid from the collection chamber into the drain.

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28. The separator of claim 25 further comprising an annular flow restrictor positioned at the upstream opening of the collection chamber, the flow restrictor being sized for free flow of liquid along the inside wall of the tube into the chamber and for blocking back-flow out of the chamber.

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29. The separator of claim 26 in which the flow restrictor diverges conically in the downstream direction to define a converging entrance to the collection chamber.

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30. The separator of claim 25 in which the flow interrupter includes a first portion that projects into the collection chamber and extends longitudinally from the inside wall of the tube downstream of the drain with respect to the swirling flow of liquid in the collection chamber.

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31. The separator of claim 28 in which the flow interrupter further includes a second portion that extends from the first portion to a position generally radially inwardly of the drain.

32. The separator of claim 25 in which the vanes extend for longitudinal distance of approximately four and one-half (4-½) inches.

33. The separator as defined in claim 25 in which the flow interrupter includes

- 5 a) a reservoir located radially outwardly of the collection chamber and in fluid communication with the drain, and
- b) a transition opening establishing fluid communication between the collection chamber and the reservoir, the transition opening being defined in part with an inlet-side transition edge extending longitudinally in the tube upstream of
- 10 the drain with respect to the swirling liquid in the collection chamber.

34. A separator for a mist collection system comprising:
- a) a cylindrical tube provided with inlet and exit openings to allow air to be drawn therethrough,
 - b) a set of stationary vanes connected in the upstream portion of the tube and sized and positioned to direct the air flowing therethrough in a cyclonic path through the tube such that mist in the air therein migrates outwardly to and in the downstream direction along the inside wall of the tube,
 - c) an annular collection chamber defined in the downstream end of the tube and having an annular upstream opening coaxial with the inside wall of the tube such that liquid flowing along the inside of the tube toward the downstream end thereof flows directly into the collection chamber,
 - d) a drain positioned near the downstream end of the collection chamber, and
 - e) a flow interrupter configured to interrupt the flow of liquid in the collection chamber and to direct the liquid from the collection chamber into the drain, the flow interrupter having
 - i) a reservoir located radially outwardly of the collection chamber and in fluid communication with the drain, and
 - ii) a transition opening establishing fluid communication between the collection chamber and the reservoir, the transition opening being defined in part with an inlet-side transition edge extending longitudinally in the tube upstream of the drain with respect to the swirling liquid in the collection chamber.

35. The separator as defined in claim 34 in which the reservoir is sized with a cross-sectional flow area of between approximately one-fourth to one-third the cross-sectional flow area of the annular collection chamber.

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36. The separator as defined in claim 42 in which the reservoir includes a first reservoir part having a first curved side extending concavely outwardly from the longitudinally extending first transition edge to establish a smoothly transitioning flow path from the collection chamber across the transition edge and into the reservoir.

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37. The separator as defined in claim 36 in which the reservoir further includes a second reservoir part having a second transition edge extending longitudinally in the tube and spaced downstream of the drain with respect to the swirling liquid in the collection chamber, and having a second side closing the reservoir between the first side and the second transition edge.

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38. The separator as defined in claim 37 in which the flow interrupter is provided in the form of a semi-cylindrical drop-down chamber with its center axis parallel to but offset from the center axis of the annular chamber, the drop-down chamber having the reservoir defined therein and being connected longitudinally along the transition edges to the tube.

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39. The separator as defined in claim 38 in which the radius of the semi-cylindrical drop-down chamber is between one-third to two-thirds the radius of the tube.

40. The separator as defined in claim 38 in which the center axis of the semi-cylindrical drop-down chamber is offset from the center axis of the tube by a distance
5 approximately equal to the sum of the radii of the tube and the drop-down chamber.